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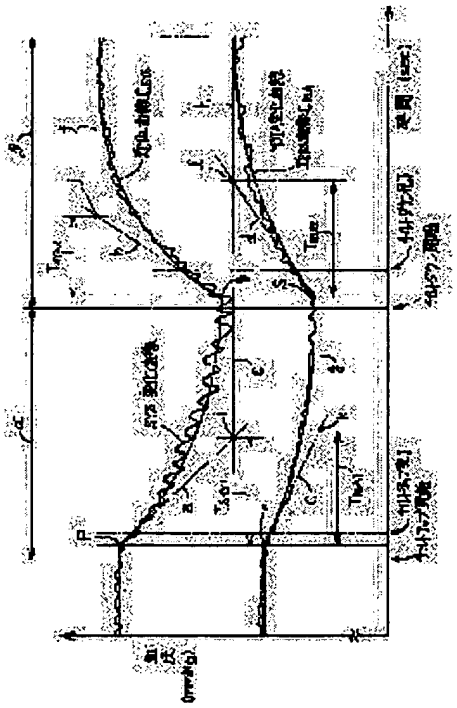
(54) APPARATUS FOR MEASURING DEGREE OF AUTONOMIC IMBALANCE

(57)Abstract:
PURPOSE: To provide an apparatus capable of measuring the degree of a autonomic imbalance quantitatively.
CONSTITUTION: In a living body generating orthostatic hypotension owing to a functional disorder of autonomic nerve, a maximum blood pressure value SYS change curve caused by tilt-up for example can be assumed as a primary delay transmitting function shown by an approximate curve CSYS, so that a time constant TSYS1 is determined on the basis of the intersection point (i) of a tangential line (a) at a point (p) of the approximate line CSYS from which blood pressure fall is started by the tilt-up and a tilt-up balanced blood pressure value line (e) of the analogous curve CSYS. Then the time constant TSYS1 represents quantatively the degree of autonomic imbalance.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] It is a measuring device whenever [for measuring quantitatively a malfunction degree of a living body's autonomic nerve characterized by providing the following / autonomic-imbalance]. A blood-pressure-measurement means by which said living body's posture carries out multiple-times measurement of the blood-pressure value of this living body that changes in relation to having changed between the 1st predetermined posture and the 2nd posture which stood up from this 1st posture A time constant decision means to determine a time constant of this first-order-lag transfer function based on two or more blood-pressure values which assumed a blood-pressure change curve when said living body's posture changes to be a first-order-lag transfer function, and were acquired by said blood-pressure-measurement means in order to measure a malfunction degree of said autonomic nerve quantitatively

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[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to a measuring device whenever [for measuring the malfunction degree of a living body's autonomic nerve quantitatively / autonomic-imbalance].
[0002]
[Description of the Prior Art] If the functional disorder of an autonomic nerve is produced, when it stands up, it is known like autonomic imbalance that blood pressure will present various symptoms, such as the so-called orthostatic hypotension which falls sharply. The diagnosis of the orthostatic hypotension by the functional disorder of this autonomic nerve is performed by measuring that patient's blood-pressure value by the so-called auscultation, after making a patient usually stand up from the condition of having lain down. Moreover, while recording trends, such as a blood-pressure value which carried out repeat measurement automatically using the cuff at the time of a change of position, on a record medium as indicated by JP,60-83603,U which these people applied previously and was exhibited, based on detecting a patient's posture serially and displaying the posture on said record medium, it considers diagnosing said orthostatic hypotension.
[0003]
[Problem(s) to be Solved by the Invention] However, there was a defect which cannot judge the orthostatic hypotension improvement effect by drugs easily objective, for example from the diagnosis of the conventional orthostatic hypotension by the blood-pressure value measured with automatic blood-pressure-measurement equipment equipped with this auscultation and cuff being qualitatively performed based on the blood-pressure change by change of a posture, and not being carried out quantitatively.
[0004] The place which succeeds in this invention against the background of the above situation, and is made into the purpose is to offer a measuring device whenever [autonomic-imbalance / which can measure the malfunction degree of an autonomic nerve quantitatively].
[0005]
[Means for Solving the Problem] As a result of this invention person's repeating various examination, while a blood-pressure change curve at a time of making it change between a posture which lay down, for example, and a posture which stood up at a predetermined angle could assume the patient's posture as a first-order-lag transfer function in a patient who produces orthostatic hypotension by functional disorder of an autonomic nerve, it found out that a time constant of the first-order-lag transfer function was what expresses a malfunction degree of an autonomic nerve quantitatively.
[0006] A place which succeeds in this invention based on this knowledge, and is made into the summary As it is a measuring device whenever [for measuring a malfunction degree of a living body's autonomic nerve quantitatively / autonomic-imbalance] and is shown in drawing corresponding to a claim of drawing 1 (a) A blood-pressure-measurement means by which said living body's posture carries out multiple-times measurement of the blood-pressure value of the living body which changes in relation to having changed between the 1st predetermined posture and the 2nd posture which stood up from the 1st posture, (b) In order to measure a malfunction degree of said autonomic nerve quantitatively, a blood-pressure change curve when said living body's posture changes is assumed to be a first-order-lag transfer function. It is in including a time constant decision means to determine a time constant of the first-order-lag transfer function based on two or more blood-pressure values acquired by said blood-pressure-measurement means.
[0007]
[Function and Effect(s) of the Invention] The blood-pressure value of the living body from whom a living body's posture changes whenever [autonomic-imbalance / of this configuration] in relation to having changed between the 1st

predetermined posture and the 2nd posture which stood up from the 1st posture according to the measuring device While multiple-times measurement is carried out by the blood-pressure-measurement means, based on two or more blood-pressure values which assumed the blood-pressure change curve when the posture changes to be a first-order-lag transfer function with the time constant decision means, and were measured by the blood-pressure-measurement means, the time constant of the first-order-lag transfer function is determined. Thus, since the value based on the time constant or it which was determined is what expresses the malfunction degree of an autonomic nerve quantitatively, it can measure the malfunction degree of an autonomic nerve quantitatively based on this time constant. The orthostatic hypotension improvement effect by drugs can be judged objective by this looking at change of the malfunction degree of the autonomic nerve quantitatively measured based on the time constant.

[0008]

[Example] Hereafter, one example of this invention is explained to details based on a drawing.

[0009] Drawing 2 is drawing showing an example of a measuring device whenever [autonomic-imbalance / of this invention], and 10 is posture change equipment. Posture change equipment 10 is equipped with the berth 15 established in the upper limit section of a stanchion 12 rotatable with the shaft 14, and the driving gear 16 for rotating the berth 15 to the circumference of a shaft 14. this driving gear 16 is equipped with the chain 24 almost wound around the output shaft (not shown) and said shaft 14 of the drive motor 20 equipped with the reducer, and its drive motor 20 between the sprocket of the pair which was prepared in rotation impossible, respectively, and which is not a drawing example, and both sprockets, and is constituted. By carrying out ON actuation of the pushdown switch for standing-up initiation which is not illustrated in this example A berth 15 is rotated in the clockwise direction in drawing 2 with comparatively loose constant speed. While being able to make it change from the level posture which shows the posture of the living body 18 on the berth 15 in drawing 2 to the posture which stood up at 45 degrees now By the below-mentioned control unit 48, if it passes during the 1 scheduled time set beforehand after standing up of said living body 18 is completed, a berth 15 will be rotated in the counterclockwise direction in drawing 2 with comparatively loose constant speed. The posture of the living body 18 on the berth 15 can be returned now from said posture which stood up to the original level location. this example -- setting -- the above -- a level posture is equivalent to the 1st posture, and the posture (only henceforth a standing-up posture) which stood up at the above-mentioned 45 degrees is equivalent to the 2nd posture.

[0010] The wrist of the living body 18 on the above-mentioned berth 15 is equipped with the probe 26 for blood pressure measurement. The housing 30 with which this probe 26 is arranged so that the shape of a container may be accomplished and a opening edge may counter the surface of a living body's 18 wrist 28 as shown in drawing 3 , The wearing band 32 for attaching the housing 30 in a wrist 28 removable, It has the planar pressure sensor 36 formed through diaphram 34 possible [relative displacement] and possible [the projection from the opening edge of housing 30] in housing 30, and the pressure room 38 is formed of these housing 30 and diaphram 34 grade. In this pressure room 38, pressure flow objects, such as pressure air, are supplied through a pressure regulating valve 42 from the fluid source of supply 40, and, thereby, the planar pressure sensor 36 is pressed by the surface of a wrist 28 by the thrust according to the pressure in the pressure room 38.

[0011] The above-mentioned planar pressure sensor 36 equips the press side 44 of the semiconductor chip which consists of single crystal silicon etc. with pressure sensing elements (not shown), such as pressure-sensitive die DODO, when pressed by the surface of a wrist 28, detects the pressure signal SM containing the pressure pulse wave which occurs from a radial artery 46 and is transmitted to the surface of a wrist 28, and supplies them to a control unit 48 through the A/D converter which does not illustrate the pressure signal SM.

[0012] The control unit 48 consists of so-called microcomputers equipped with CPU, ROM, RAM, an I/O Port, etc. CPU Signal processing is performed using the memory storage function of RAM for ROM according to the program memorized beforehand. The pressure in the pressure room 38 is adjusted by controlling a pressure regulating valve 42 through the drive circuit which is not illustrated. While determining the optimal thrust of the planar pressure sensor 36 based on the pressure pulse wave contained in the pressure signal SM serially acquired in the **** pressure-up process in the pressure room 38 and controlling a pressure regulating valve 42 to maintain the optimal thrust A living body's 18 highest-blood-pressure value and lowest-blood-pressure value are determined for every beat of the pressure pulse wave serially detected in the optimal thrust, and the determined blood-pressure value is made to carry out a trend display and record on a display and a recording device 50. Moreover, the determined time constant is displayed on a display and a recording device 50, and CPU is made to record, while determining the time constant of the first-order-lag transfer function with which the blood-pressure change curve at the time of making it change between a horizontal position and a standing-up posture expresses the posture of the living body 18 on a berth 15 with ROM according to the program memorized beforehand.

[0013] Hereafter, actuation of a measuring device is explained according to the flow chart of drawing 4 whenever

[autonomic-imbalance / of this example].
[0014] it is held by the optimal thrust, while the optimal thrust of the planar pressure sensor 36 will be determined by performing step S1 based on the pressure for example, in the pressure room 38 where the pressure pulse wave of a peak swing is obtained in the process to which the **** pressure up of the inside of the pressure room 38 is carried out after initial processing which is not a drawing example is performed if a power supply is switched on. Next, it is judged by performing step S2 whether the pressure signal SM was read and one beat of pressure pulse waves was detected. Although repeat activation of step S2 is carried out when decision of step S2 is denied By performing step S3, and performing step S4, after the highest-blood-pressure value SYS and the lowest-blood-pressure value DIA are determined and memorized based on the magnitude of the pressure signal SM in the pressure pulse wave top peak detected at step S2, and a bottom peak when affirmed The trend display of the determined blood-pressure value is carried out to a display and a recording device 50, and it is recorded on it.
[0015] It is judged in continuing step S5 whether the contents of the flag F are "1." In the below-mentioned step S8, as for this flag F, those contents are set as "1." When decision of step S5 is denied, it is judged whether step S6 was performed and standing up (henceforth a tilt rise) from a living body's 18 horizontal position was started. This judgment is made based on whether ON actuation of said pushdown switch for standing-up initiation was carried out, for example. Repeat activation of less than [step S2] is carried out, when decision of step S6 is denied, while the blood-pressure values SYS and DIA are determined and memorized for every beat of a pressure pulse wave, a trend display is carried out, but when decision of step S6 is affirmed, step S7 is performed.
[0016] In the above-mentioned step S7, after a tilt rise is started, it is judged whether it went through fixed time amount alpha defined beforehand. This fixed time amount alpha is set as the value which added the time amount for about 1 minute to the time amount which includes the time amount to which a blood-pressure value may reach an abbreviation balance after a tilt rise is completed, as shown in drawing 5 , considers as a living body 18 not fainting by the pressure decrease, for example, is required by completion from tilt rise initiation. Although repeat activation of less than [step S2] is carried out, and a trend display is carried out while the blood-pressure values SYS and DIA are determined and memorized for every beat of a pressure pulse wave when decision of step S7 is denied Step S9 is performed after being set as "1" which shows that step S8 was performed and the contents of the flag F went through said fixed time amount alpha after tilt rise initiation, when affirmed.
[0017] In the above-mentioned step S9, return rotation of a berth 10 is started and the return (henceforth a tilt down) to a horizontal position from a living body's 18 standing-up posture is started. In continuing step S10, after a tilt down is started, it is judged whether it went through fixed time amount beta defined beforehand. This fixed time amount beta includes the time amount to which a blood-pressure value may reach an abbreviation balance, after a tilt down is completed, as shown in drawing 5 , for example, it is set as the value for about 1 - 1.5 minutes. When decision of step S10 is denied, repeat activation of less than [step S2] is carried out, and a trend display is carried out while the blood-pressure values SYS and DIA are determined and memorized for every beat of a pressure pulse wave. Since decision of step S5 is affirmed at this time, it is made to skip step S6 thru/or step S9.
[0018] When decision of the above-mentioned step S10 is affirmed, after step S11 is performed and exhaust gas pressure of the inside of the pressure room 38 of a probe 26 is carried out, as it is shown in drawing 5 , the time constant of the first-order-lag transfer function with which the blood-pressure change curve at the time of making it change between a horizontal position and a standing-up posture expresses the posture of the living body 18 which produces the orthostatic hypotension by the functional disorder of an autonomic nerve is determined by performing less than [step S12].
[0019] Namely, approximation curve CSYS of the change curve (henceforth a SYS change curve) of the highest-blood-pressure value SYS at the time of making it change from the standing-up posture to a horizontal position again in step S12 first, after changing a living body's 18 posture from a horizontal position to a standing-up posture And approximation curve CDIA of the change curve (henceforth a DIA change curve) of the lowest-blood-pressure value DIA It is determined, respectively. It sets to the following step S13, and is said approximation curve CSYS. While the tangent a in the blood-pressure descent start point p by tilt rise and the tangent b in the elevation-of-blood-pressure start point q by tilt down are determined, respectively, it is said approximation curve CDIA. The tangent c in the blood-pressure descent start point r by tilt rise and the tangent d in the elevation-of-blood-pressure start point s by tilt down are determined, respectively.
[0020] In continuing step S14 The balanced blood-pressure value line f which shows the highest-blood-pressure value which the highest-blood-pressure value SYS rose by the balanced blood-pressure value line e which shows the highest-blood-pressure value which the highest-blood-pressure value SYS descended by tilt rise, and reached the balance, and tilt down, and reached the balance is said approximation curve CSYS. While being based and being determined,

respectively The balanced blood-pressure value line h which shows the highest-blood-pressure value which the lowest-blood-pressure value DIA rose by the balanced blood-pressure value line g which shows the highest-blood-pressure value which the lowest-blood-pressure value DIA descended by tilt rise, and reached the balance, and tilt down, and reached the balance is said approximation curve CDIA. It is based and is determined, respectively.
[0021] Next, it sets to step S15. It is based at the intersection i of said tangent a and the balanced blood-pressure value line e, and is the approximation curve CSYS of a SYS change curve. It is based at the time constant TSYS1 of the change portion by inner tilt rise, and the intersection j of said tangent b and the balanced blood-pressure value line f. The approximation curve CSYS **, while the time constant TSYS2 of the change portion by inner tilt down is determined, respectively It is based at the intersection k of said tangent c and the balanced blood-pressure value line g, and is the approximation curve CDIA of a DIA change curve. It is based at the time constant TDIA1 of the change portion by inner tilt rise, and the intersection l of said tangent d and the balanced blood-pressure value line h. The approximation curve CDIA ** -- the time constant TDIA2 of the change portion by inner tilt down is determined, respectively.
[0022] The above-mentioned time constants TSYS1, TSYS2, TDIA1, and TDIA2 express quantitatively the malfunction degree of a living body's 18 autonomic nerve, respectively. In addition, approximation curve CSYS of the above-mentioned SYS change curve The change portion by inner tilt rise, the change portion by tilt down, and approximation curve CDIA of the above-mentioned DIA change curve The change portion by inner tilt rise and the change portion by tilt down are expressed as a first-order-lag transfer function shown in a formula 1, respectively. a formula 1 -- setting -- x -- a blood-pressure value and A1 the blood-pressure value x in case a balanced blood-pressure value and t are time constants for the elapsed time from a blood-pressure descent initiation or elevation-of-blood-pressure initiation point in time, and T and t is zero -- it is (A1+A2) -- while expressing the initial blood-pressure value -- A2 It becomes a positive value at the time of a tilt rise, and becomes a negative value at the time of a tilt down.
[0023]
[Equation 1] x=A1+A2 and exp (-t/T)
[0024] Next, while the time constants TSYS1, TSYS2, TDIA1, and TDIA2 determined at step S15 by performing step S16 are displayed on a display and a recording device 50, respectively and are recorded on it, it is terminated, after step S17 is performed and the contents of said flag F are cleared. In this example, while the above-mentioned probe 26, the fluid source of supply 40, a pressure regulating valve 42, and a control unit 48 (portion for performing the above-mentioned step S1 of the control units 48 thru/or step S3, etc. to accuracy) constitute a blood-pressure-measurement means, a control unit 48 and the portion for performing the above-mentioned step S12 of the control units 48 thru/or step S15 to accuracy constitute a time constant decision means more.
[0025] Thus, according to the measuring device, whenever [autonomic-imbalance / of this example] Since the malfunction degree of an autonomic nerve can be quantitatively measured based on the time constant of the first-order-lag transfer function with which a living body's 18 blood-pressure change curve obtained by making it change between a horizontal position and a 45-degree standing-up posture expresses a living body's 18 posture for example, in order to improve the orthostatic hypotension by the functional disorder of an autonomic nerve, when a living body 18 is medicated with drugs By seeing change of the malfunction degree of the autonomic nerve quantitatively measured based on the above-mentioned time constant, the orthostatic hypotension improvement effect by the drugs can be judged objective. Here, drawing 6 and drawing 7 are L-threo -3 and 4-dihydroxyphenylserine (L-DOPS) which are the precursor of a noradrenalin as the above-mentioned drugs. When it is used, an example of change of the time constant by change of the dose per day of the drugs L-DOPS is shown, respectively, drawing 6 shows change of the time constants TSYS1 and TDIA1 at the time of a tilt rise, and drawing 7 shows change of the time constants TSYS2 and TDIA2 at the time of a tilt down. In drawing 6 , the dose of drugs L-DOPS takes the time constants TSYS1 and TDIA1 at the time of a tilt rise for increasing, and it is large, respectively. While it is shown quantitatively that the dose of drugs L-DOPS follows on increasing, and the pressure decrease by tilt rise is controlled In drawing 7 , the dose of drugs L-DOPS takes the time constants TSYS2 and TDIA2 at the time of a tilt down for increasing, and it is small, respectively. It is shown quantitatively that the dose of drugs L-DOPS follows on increasing, and the return of the blood pressure by tilt down is promoted. Thereby, the orthostatic hypotension improvement effect by drugs L-DOPS can be judged objective.
[0026] As mentioned above, although one example of this invention was explained based on the drawing, this invention is applied also in other modes.
[0027] for example, although the time constant of the first-order lag transfer function with which the approximation curve of the blood pressure change curve when change a living body 18 posture express be determine in said example based on the intersection of the tangent and the balanced blood pressure value line in an initial blood pressure value, you may make it determine a time constant based on the point on the approximation curve corresponding to 63.2% value of

change which result in a balanced blood pressure value from an initial blood pressure value.
[0028] Moreover, a balanced blood-pressure value (equivalent to A1 in said formula 1), an initial blood-pressure value (equivalent to A1+A2 in case t in a formula 1 is zero), And it is based on three blood-pressure values of the blood-pressure value in the time amount of the arbitration between both [these] blood-pressures values, and is one formulaA2. And can also constitute so that a time constant T may be determined, and Or based on three blood-pressure values of the arbitration called for in the blood-pressure process, the time constant of an approximation curve may be called for from the first-order-lag transfer function shown in a formula 1 without using these first stage blood-pressure value and a balanced blood-pressure value. It is also possible to measure the three above-mentioned blood-pressure values with blood-pressure-measurement equipment equipped with the cuff etc. in these cases.
[0029] Moreover, although said example explained that the orthostatic hypotension improvement effect by drugs could be judged objective by seeing change of the time constant which expresses the malfunction degree of an autonomic nerve quantitatively, the magnitude of a time constant is beforehand classified gradually for every predetermined range, and you may make it judge the effect of drugs by seeing the value change which shows the range where an actual time constant belongs. Since the value which shows the range where this actual time constant belongs also expresses the malfunction degree of an autonomic nerve quantitatively, the effect of drugs can be judged objective.
[0030] Moreover, in said example, although the time constant of a SYS change curve and a DIA change curve is determined, respectively at the time of a tilt rise and a tilt down, the time constant of either a SYS change curve and a DIA change curve may be determined, the time constant of an average blood pressure change curve may be determined, and a time constant may be determined in either at the time of a tilt rise and a tilt down.
[0031] Moreover, although it consists of said examples so that only the time constant determined this time may be displayed and recorded Two or more time constants for which it asked whenever the necessity does not exist, for example, it changed the dose of drugs are not necessarily memorized for every living body with the dose of the drugs. May make it display and record the time constant of these plurality on a 2-dimensional coordinate, as shown in said drawing 6 and drawing 7 , and Or the sequential storage of two or more time constants for which it asked for every predetermined time is carried out for every living body, and you may make it display and record the time constant of these plurality on the 2-dimensional coordinate of the shaft and time-axis which show the magnitude of a time constant.
[0032] Moreover, it consists of said examples so that [a living body's 18 posture] it may be changed by the berth 15 between a horizontal position (the 1st posture) and a 45-degree standing-up posture (the 2nd posture), but the 1st posture of the living body 18 changed by the berth 15 may be a posture which inclined at the comparatively small angle, and even if the 2nd posture is a posture which stood up at predetermined angles other than 45 degree, it does not interfere.
[0033] Moreover, although it consists of said examples so that the time constant of the first-order-lag transfer function with which the blood-pressure change curve when changing a living body's 18 posture with posture change equipment 10 equipped with the berth 15 expresses may be determined The necessity can also not necessarily measure the malfunction degree of the living body's autonomic nerve by determining the time constant of the first-order-lag transfer function with which a blood-pressure change curve when there is nothing, for example, a living body starts on a chair from a seat beam posture expresses.
[0034] Moreover, although the blood-pressure value is determined in said example based on the pressure pulse wave which determines the optimal thrust of the planar pressure sensor 36, and is serially detected in the optimal thrust, the necessity does not exist, and it can also not necessarily be constituted so that a blood-pressure value may be determined based on the pressure pulse wave which holds to the predetermined thrust which was able to define the planar pressure sensor 36 beforehand, and is serially detected by the thrust.
[0035] In addition, in the range in which this invention does not deviate from the meaning, modification may be added variously.

[Translation done.]

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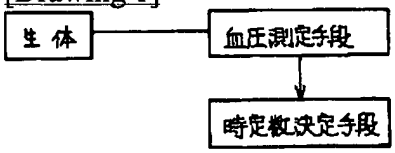
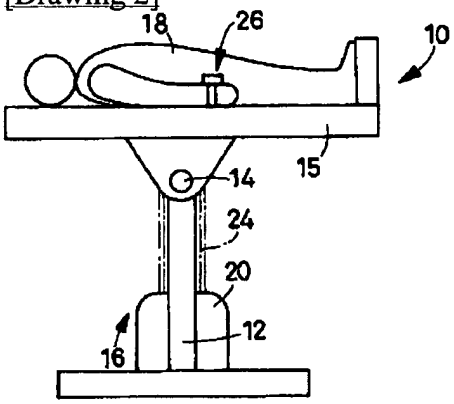
DRAWINGS

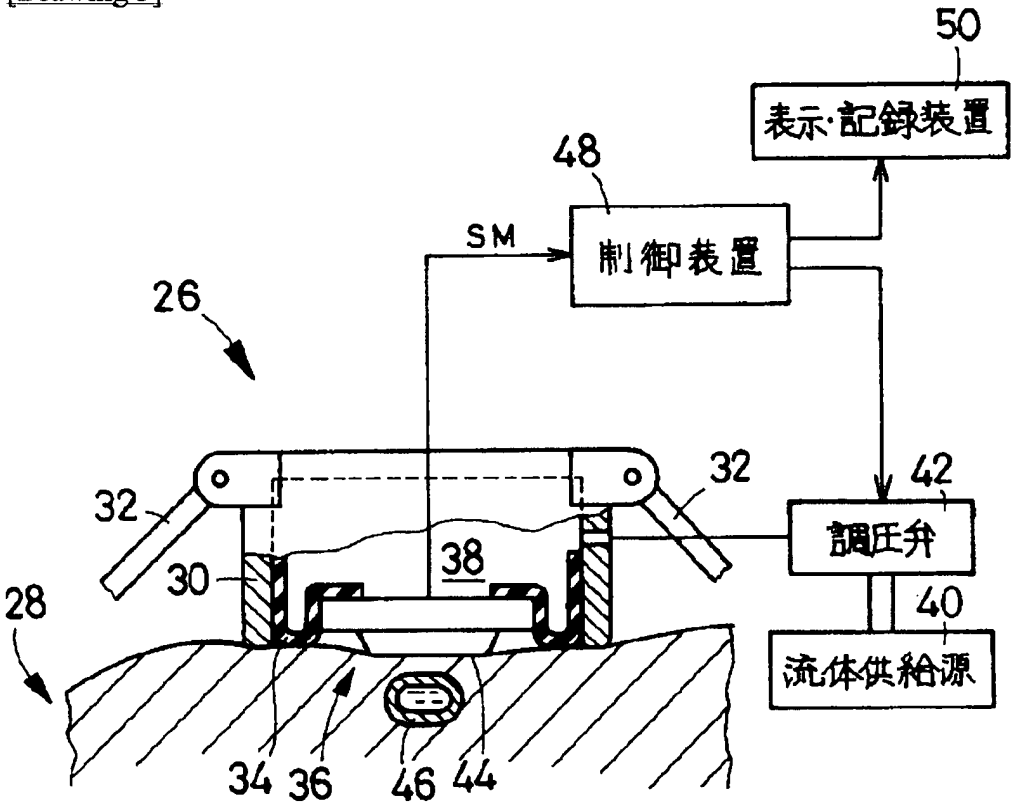
[Drawing 1]



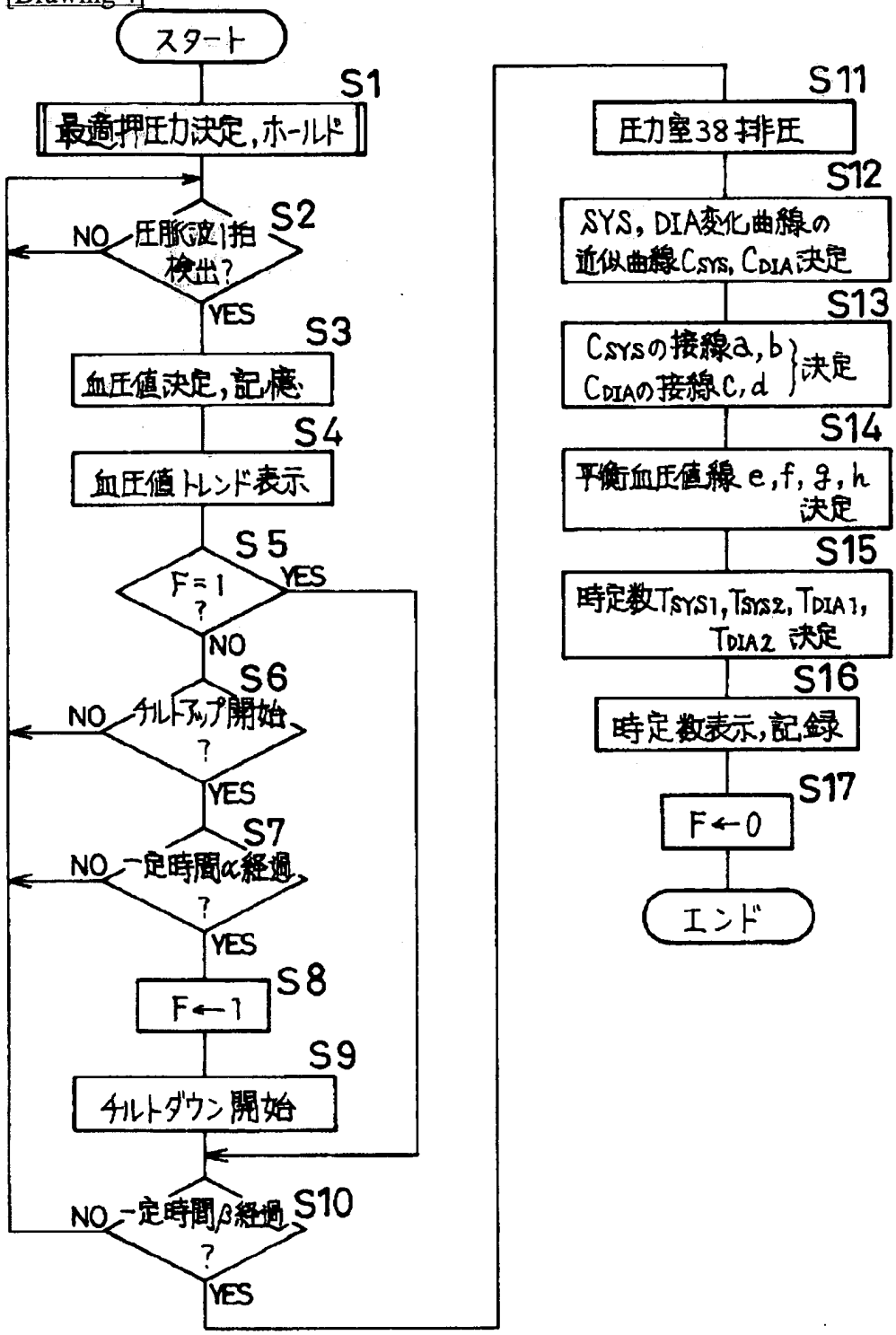
[Drawing 2]



[Drawing 3]



[Drawing 4]



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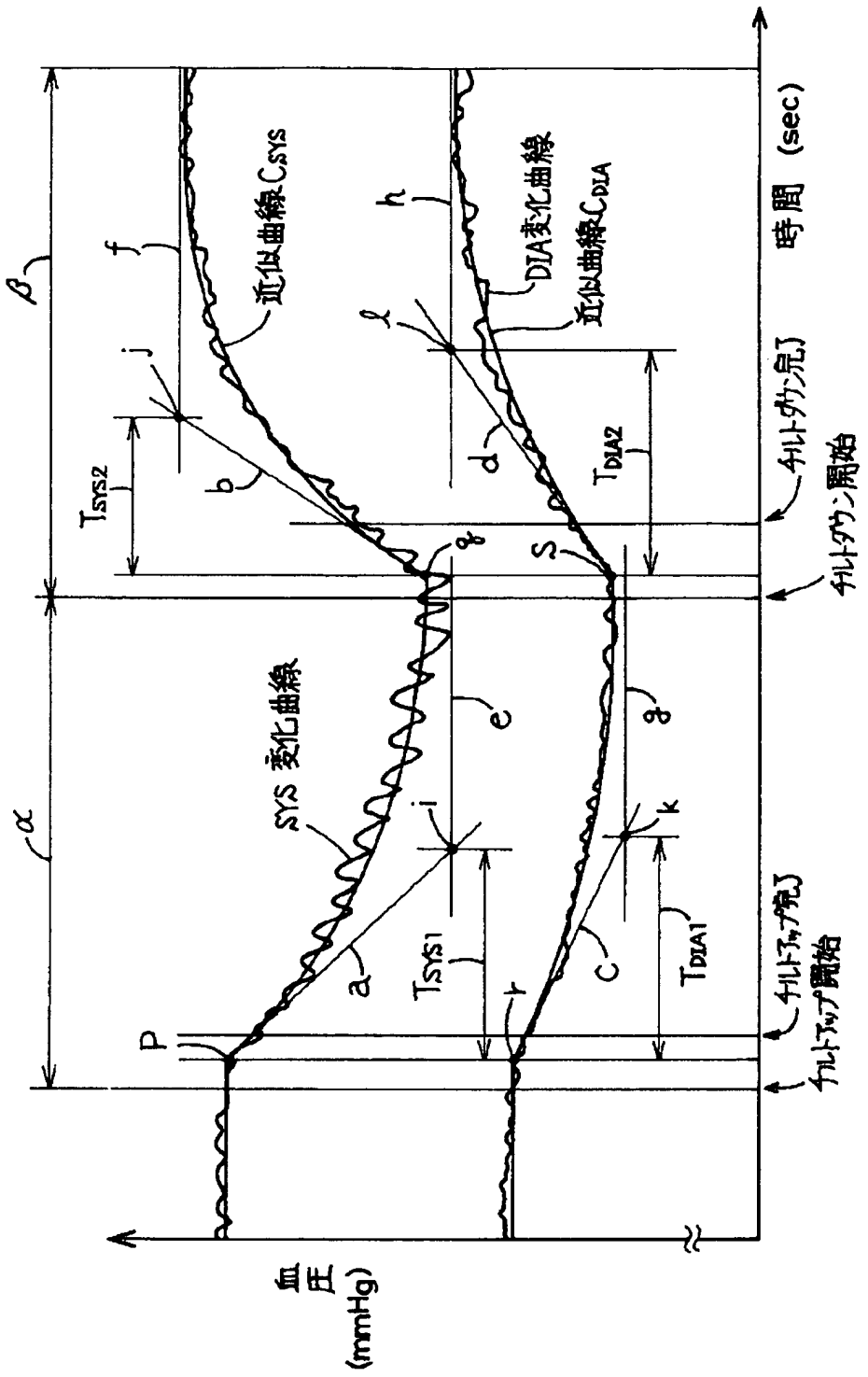
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α
β
P
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b
c
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カルトアップ完了
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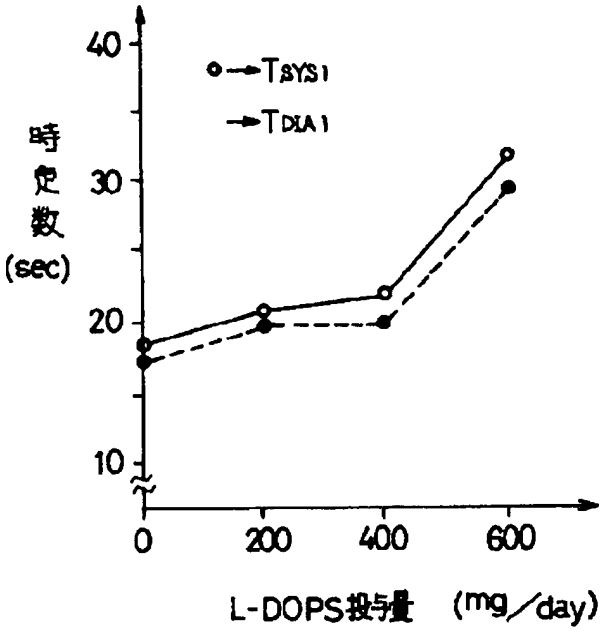
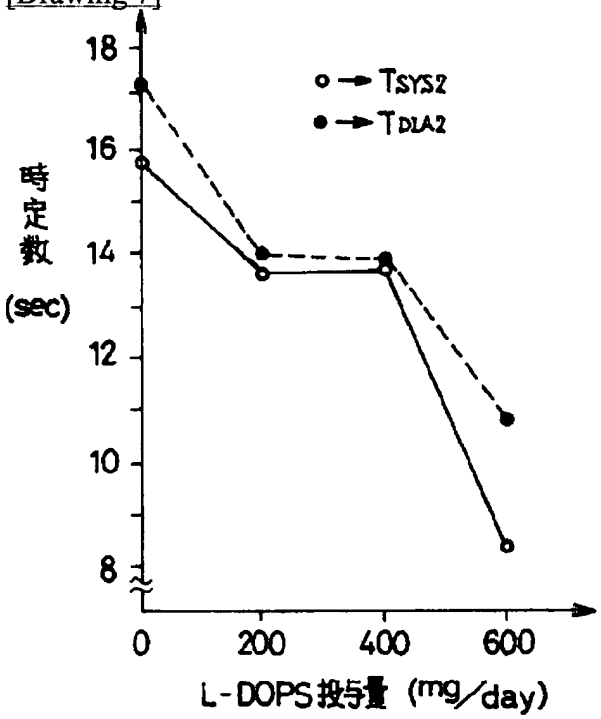
カルトダウン完了

[Drawing 6]



[Drawing 7]



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